DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

JUL 17 2001

FROM: HQ AFCESA/CESC
139 Barnes Drive, Suite 1
Tyndall AFB FL 32403-5319

SUBJECT: **Engineering Technical Letter (ETL) 01-9: Procedures to Retard Reflective Cracking**

1. Purpose. This ETL provides guide specifications for retarding reflective cracking in hot-mix asphalt (HMA) overlays on concrete.

2. Application. The requirements of this ETL are optional, but are proven methods for retarding reflective cracking.

2.1. Authority: Unified Facilities Criteria (UFC) 3-260-02, *Pavement Design for Airfields*.

2.2. Effective Date: Immediately.

2.3. Ultimate Recipients:

- Air Force major command (MAJCOM) engineers.
- Base civil engineers (BCE) and other engineers responsible for design of contingency airfield pavements.
- U.S. Army Corps of Engineers (USACE) and Navy offices responsible for Air Force design and construction.

2.4. Coordination: MAJCOM pavement engineers.

3. Referenced Publications:

- UFC 3-260-02, *Pavement Design for Airfields*
- American Society for Testing and Materials (ASTM) D 3405, *Standard Specification for Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements*
- Asphalt Institute Manual Series 6 (MS6), *Asphalt Pocketbook of Useful Information*
- Asphalt Institute MS17, *Asphalt Overlays and Pavement Rehabilitation*

4. Acronyms and Terms:

ASTM - American Society for Testing and Materials
BCE - base civil engineer
CV - coefficient of variation
ETL - Engineering Technical Letter
HMA - hot-mix asphalt

MAJCOM - major command
NDT - nondestructive testing
PCC - portland cement concrete
RPCC - reinforced portland cement concrete
UFC - Unified Facilities Criteria
USACE - U.S. Army Corps of Engineers

5. Background. Reflective cracking is a common distress in asphalt overlays of concrete. Cracking is caused by concrete slab movement, and is primarily due to environment and load. Cracking normally starts at the interface and spreads to the surface, causing early pavement deterioration and failure. Numerous procedures, methods, and materials have been developed to retard reflective cracking, with varying results. Construction guide specifications for three of the more successful procedures, developed by the Asphalt Institute (Manual Series 17 [MS17], *Asphalt Overlays and Pavement Rehabilitation)*, are provided in this ETL.

6. Contact. Recommendations for improvements to this ETL are encouraged and should be furnished to: HQ AFCESA/CESC, 139 Barnes Drive, Suite 1, Tyndall AFB, FL 32408-5319, Attention: Mr Jim Greene, DSN 523-6334, commercial (850) 283-6334, FAX DSN 523-6219, Internet james.greene@tyndall.af.mil.

MICHAEL J. COOK, Colonel, USAF
Technical Director

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1. Rubblizing Concrete Pavements
2. Saw-Cut and Seal
3. Crack/Break and Seat
4. Distribution List

RUBBLIZING CONCRETE PAVEMENTS

A1.1. Description of Work. This work consists of rubblizing and seating (rolling) the existing portland cement concrete (PCC) pavement prior to placing a new HMA overlay. The work shall be accomplished in accordance with the standard specifications, special provisions, and the details shown in the plans.

A1.2. Equipment.

A1.2.1. Rubblization and Seating Equipment. Rubblization shall be accomplished by the use of a pavement breaker machine that is capable of delivering sufficient energy to rubblize the pavement full-depth in a manner that completely destroys the concrete slab and all slab action. Sufficient seating equipment shall be used to thoroughly settle the rubblized concrete and to provide a smooth surface for the HMA overlay. The type of rubblization machine and the minimum types of associated rolling equipment used in the rubblization process shall be specified in the project special provisions as either the resonant barrier process or the multi-header breaker process.

A1.2.2. Resonant Breaker Process.

A1.2.2.1. Resonant Breaker Machine. This is a self-contained, self-propelled resonant frequency breaker specifically designed for the purpose of rubblizing PCC pavement. The machine shall be capable of producing low-amplitude (25.4 millimeters [1 inch] maximum) blows of 8.89 kilonewtons (2000 pounds force), and delivering blows to the existing PCC surface at a rate of not less than 44 cycles per second. If necessary, the breaker shall be equipped with a screen to protect vehicles in the adjacent lane from flying chips during the fracturing process.

A1.2.2.2. Resonant Breaker Seating Equipment. The contractor shall provide and use a smooth steel drum vibratory roller. The roller shall have a gross weight of at least 9.1 metric tons (10 tons), as operated in the vibratory mode, to settle and seat the rubblized pavement and provide a smooth surface for the HMA overlay.

A1.2.3. Multi-Head Breaker Process.

A1.2.3.1. Multi-Head Breaker Machine. This is a self-contained, self-propelled multi-head breaker specifically designed for the purpose of rubblizing PCC pavement. The machine shall be capable of rubblizing the pavement a minimum width of 3.9 meters (13 feet) per pass. Pavement-breaking hammers shall be mounted laterally in pairs, with half the hammers in a forward row and the remainder diagonally offset in a rear row so there is continuous breakage from side to side. The lift height of the hammers shall be independently adjustable. If necessary, the breaker shall be equipped with a screen to protect vehicles in the adjacent lane from flying chips during the fracturing process.

A1.2.3.2. Multi-Head Breaker Seating Equipment.

A1.2.3.2.1. The contractor shall provide and use the following seating equipment:

A1.2.3.2.1.1. Z-Grid Roller. This is a vibratory steel drum roller fitted with a "Z" pattern grid on the drum face. The roller shall have a gross weight of at least 9.1 metric tons, as operated in the vibratory mode, to settle and seat the rubblized pavement, and provide a smooth surface for the HMA overlay.

A1.2.3.2.1.2. Pneumatic-Tire Roller. A pneumatic-tire roller with a gross weight of at least 22.7 metric tons (25 tons) shall be used after the Z-grid roller to further settle and seat the rubblized pavement.

A1.2.3.2.1.3. Smooth Steel Drum Vibratory Roller. The contractor shall provide and use a smooth steel drum vibratory roller. The roller shall have a gross weight of at least 9.1 metric tons, as operated in the vibratory mode, to settle and seat the rubblized pavement and provide a smooth surface for the HMA overlay.

A1.2.3.2.2. Rubblization machines and rollers of other design that will accomplish similar results may also be used with the approval of the contracting officer. All rubblization and seating equipment necessary to perform the work will be considered essential to the completion of the project, and will not be paid for separately.

A1.3. Construction Requirements.

A1.3.1. Drainage System. See paragraph A1.6.1. Longitudinal pipe edge drains with lateral outlets shall be installed adjacent to all existing PCC pavement to be rubblized as shown on the plans. The design details and the complete extent of the edge drain system on the project shall be as shown on the plans. A separate pay item is provided for drainage in these specifications.

A1.3.2. Removal of Existing Asphalt Overlay and Surface Patches. See paragraph A1.6.2. The contractor shall remove all existing asphalt from the PCC pavement surfaces to be rubblized. This includes existing asphalt overlays and asphalt surface patches.

A1.3.3. Preparation Prior to Rubblization.

A1.3.3.1. Drainage System Installation. Prior to rubblization operations, drainage systems as specified on the plans shall be installed. Drainage systems shall be properly functioning for a minimum of two weeks prior to rubblization.

A1.3.3.2. Removal of Existing Asphalt Surfaces. Prior to the rubblization operations, existing asphalt overlays and patches shall be removed from the PCC pavement surfaces to be rubblized. Existing full-depth asphalt patches shall remain in place, unless directed for removal by the contracting officer.

A1.3.3.3. Saw-Cut Joints: A new full-depth saw-cut joint shall be made along an existing joint at all ramps and mainline pavement where rubblized PCC abuts pavement that will remain in place. All load transfer devices between the planned rubblization and PCC pavement remaining in place shall be severed.

A1.3.3.4. Shouldering. Shoulder adjustments and/or any pavement widening shall be completed up to the elevation of the existing pavement grade prior to beginning the rubblization operations. These areas can be used to support the rubblization machines while the existing PCC pavement is being rubblized.

A1.3.4. Test Strip and Test Pit to Establish Procedure.

A1.3.4.1. Test Strip. Before the rubblization operations begin, the contracting officer will designate a test section of approximately 150 meters by 3.6 meters (500 feet by 12 feet). The contractor shall rubblize the test section using varying degrees of energy and/or various striking heights until a procedure is established that will rubblize the pavement to the required extent as contained in these specifications.

A1.3.4.2. Test Pit. A 1.2-meter (4-foot) square test pit shall be excavated in the middle of the test strip, at a location selected by the contracting officer, to determine that the breaker is producing pieces of the specified sizes as contained in these specifications. The rubblized particle sizes shall be checked throughout the entire depth of the pavement. The contracting officer may require additional test pits. The test pit material shall be removed from the project and the hole filled using coarse aggregate material as determined by the contracting officer. The replacement material shall be placed and properly compacted by the contractor.

A1.3.4.3. The contracting officer and the contractor shall mutually agree upon the rubblization procedure. The established procedure shall be used to rubblize the remainder of the pavement. The contractor shall continuously monitor the rubblization operation, and make minor adjustments in the striking pattern, striking energy, number of passes, and other factors necessary to continually achieve acceptable breaking throughout the project. The contractor shall inform the contracting officer of any major adjustments that may be required in the process to provide rubblized pavement that conforms to the specification requirements contained herein. Additional test pits may be required by the contracting officer to confirm that the PCC pavement is adequately rubblized.

A1.3.5. Rubblization Criteria. See paragraph A1.6.3.

A1.3.5.1. The existing concrete pavement shall be rubblized to the required extent for the specific rubblization process specified in the project special provisions as either the resonant breaker process or multi-head breaker process.

A1.3.5.1.1. Resonant Breaker Process. The existing PCC pavement shall be broken into pieces ranging from sand size to pieces generally 150 millimeters (6 inches) or less

in size. No individual piece shall exceed 200 millimeters (8 inches) in any dimension. The majority of the rubblized concrete shall be 25 to 75 millimeters (1 to 3 inches) in size. For reinforced portland cement concrete (RPCC) pavement, the reinforcing steel shall be debonded from the concrete and left in place, unless protruding above the surface. Concrete pieces below the reinforcing steel shall be reduced to the greatest possible extent, and no individual piece shall exceed 200 millimeters in any dimension.

A1.3.5.1.2. Multi-Head Breaker Process. The existing PCC pavement shall be broken into pieces ranging from sand size to pieces generally 75 millimeters or less in size in the top half of the pavement, and 225 millimeters (9 inches) or less in the bottom half of the pavement. No individual piece shall exceed 225 millimeters in any dimension. For RPCC pavement, the reinforcing steel shall be debonded from the concrete and left in place, unless protruding above the surface. Concrete pieces below the reinforcing steel shall be reduced to the greatest possible extent, and no individual piece shall exceed 225 millimeters in any dimension.

A1.3.5.2. Due to lack of edge support, concrete pieces below the reinforcing steel up to 300 millimeters (12 inches) in any dimension will be accepted along the outside edge of the existing PCC pavement, up to 300 millimeters from the edge.

A1.3.6. General Rubblization Procedures.

A1.3.6.1. The rubblization shall be done in partial widths when necessary to maintain traffic as shown on the plans and contained in the contract documents.

A1.3.6.2. When rubblizing in a lane adjacent to a lane that is open to traffic, measures shall be taken to prevent debris from entering the traffic lane.

A1.3.6.3. In areas where the roadway must be overlaid one lane at a time, initial rubblization will extend a minimum of 150 millimeters beyond the width of the pavement to be overlaid.

A1.3.6.4. For the resonant breaker process, rubblizing shall begin at a free edge or previously broken edge and progress toward the opposite shoulder or longitudinal centerline of the road. Continuous coverage of the entire PCC pavement surface, overlapped if necessary to achieve adequate rubblization with the breaking shoe, shall be required. Additional passes of the resonant breaker machine may be required if larger concrete pieces remain above the reinforcement.

A1.3.7. Dust Control. The contractor shall minimize the dispersion of dust from the rubblization operation until the rubblized surface is overlaid with HMA. The contractor shall provide a water truck, operator, and all water necessary for dust-control purposes. Excessive water shall not be applied to the rubblized surface. Dust control is incidental to the rubblization process and will not be paid for separately. The contracting officer shall approve dust-mitigation measures.

A1.3.8. Damage to Base, Underlying Structures, and Other Facilities. The rubblization machine and rollers shall be operated in a manner that will avoid damaging the base, underlying structures, utilities, drainage facilities, bridge approach slabs, bridge decks, and other facilities on the project. If any damage occurs, the contractor shall immediately cease his operations, notify the contracting officer, and repair the damage at the direction of the contracting officer. Repairs shall be made in a timely manner and at the expense of the contractor.

A1.3.9. Removal of Exposed Reinforcing Steel. Reinforcing steel in the rubblized pavement, if any, shall generally be left in place. Reinforcing steel that becomes exposed at the surface during the rubblization process or rolling operations shall be cut flush with the rubblized surface, or slightly below the surface, and removed from the project by the contractor. The contractor shall also remove any loose joint filler, expansion materials, or other similar items.

A1.3.10. Seating Procedures.

A1.3.10.1. The contractor shall use the rolling equipment contained in these specifications as described below.

A1.3.10.1.1. Resonant Breaker Process. The rubblized PCC pavement shall be rolled with a minimum of three passes over the entire width of the pavement with a vibratory steel drum roller. For this operation, a pass is defined as forward and back over the entire surface area. The contracting officer may require additional passes to satisfactorily seat the rubblized pavement and provide a smooth surface that is ready for the HMA overlay. The roller shall be operated at a speed not to exceed 1.8 meters (6 feet) per second.

A1.3.10.1.2. Multi-Head Breaker Process.

A1.3.10.1.2.1. Prior to placing the HMA overlay, the entire width of the pavement shall be rolled by vibratory and pneumatic-tire rollers following the sequence contained herein. For this operation, a pass is defined as forward and back over the entire surface area.

A1.3.10.1.2.1.1. After rubblizing, two passes with the Z-grid roller shall follow the multi-head breaker machine, and one pass with the pneumatic-tire roller.

A1.3.10.1.2.1.2. Immediately prior to HMA overlay, roll one pass with the vibratory steel drum roller.

A1.3.10.1.2.2. The contracting officer may require additional passes of the rolling equipment to satisfactorily compact the rubblized pavement and provide a smooth surface that is ready for the HMA overlay. Additional rolling at the direction of the contracting officer shall be considered incidental to the work, and will not be paid for separately. Rolling should not be performed in wet conditions.

A1.3.11. Unstable Area Patching.

A1.3.11.1. If unstable areas occur because of expansion of the existing concrete pavement, they shall be removed to a maximum length of 1.2 meter (4 feet) in length by 3.6 meters (12 feet) in width and replaced with full-depth HMA (patching) at the direction of the contracting officer. Patching procedures shall conform to the standard specifications, and shall be completed prior to placing the HMA overlay. HMA (patching) will be paid as a separate bid item as provided in these specifications.

A1.3.11.2. Areas of poor subgrade support that are identified during the rubblization and seating process shall be patched at the direction of the contracting officer. Generally, the rubblized pavement, base course, and subgrade material will be removed from unstable areas. The material will be replaced with aggregate base course compacted in lifts as required in the standard specifications. Aggregate base course (patching) will be paid for as a separate bid item as provided in these specifications.

A1.3.11.3. Depressions in the final rubblized surface that are stable shall be corrected by adding aggregate base course (leveling) as directed by the contracting officer.

A1.3.12. Traffic Operations. Traffic will not be allowed on the rubblized pavement before the required HMA overlay has been placed. At restricted crossovers and ramp crossings, the contracting officer may waive this restriction for up to 24 hours when necessary for the maintenance of traffic, as shown in the project's traffic control plan. Rubblized crossovers and ramp crossings exposed to traffic shall be maintained in the same compacted state as other areas until the placement of the HMA overlay. Rubblized material that becomes dislodged by traffic shall be immediately removed, and the contractor shall restore the crossover to a safe operating condition.

A1.3.13. Progress of the Work. In no instance shall more than 48 hours elapse between rubblizing the pavement and the placement of the HMA overlay. If rain occurs between these operations, this time limitation may be waived to allow sufficient time for the rubblized pavement to dry to the satisfaction of the contracting officer.

A1.3.14. Asphalt Tack Coats. Asphalt tack coat material shall be placed between layers of HMA that have been exposed to traffic. The types and grades of the asphaltic material to be used are contained in these project specifications, and shall be paid for under separate line items. The volume in gallons of the materials actually used in the work shall be determined as the basis of payment for the material.

A1.4. Method of Measurement.

A1.4.1. Rubblization of concrete pavement will be measured by the square yard.

A1.4.2. Removal of existing asphalt overlay will be measured by the square yard.

A1.4.3. Drainage systems will be measured by the lineal foot. All cleanouts, outfalls, and other maintenance expenditures will be considered incidental to the work, and not paid for separately.

A1.4.4. HMA (patching) will be measured as described in the standard specifications. The HMA pavement shall be measured by truck scales, or if the plant is so equipped, by an automatic batching and mixing control system with an automatic digital printer for batch weights and component materials weights. The weight in tons of the HMA (patching) material actually used in the work shall be determined.

A1.4.5. Aggregate base course (patching) will be measured as described in the standard specifications. The weight in tons of the aggregate base course (patching) material actually used in the work shall be determined.

A1.4.6. Aggregate base course (leveling) will be measured as described in the standard specifications. The weight in tons of the aggregate base course (leveling) material actually used in the work shall be determined.

A1.4.7. Unclassified excavation will be measured by the volume of materials removed. The volume will be determined by taking the average length, width, and depth.

A1.5. Basis of Payment. The accepted quantities will be paid at the contract unit price for the pay items listed in Table A1.

Note: Traffic Control is a separate pay item that is not included in these specifications.

Table A1. Basis of Payment

Pay Item	Pay Unit
Concrete pavement rubblization	square yard
Removal of existing HMA overlay and surface patches	square yard
Drainage system	lineal foot
HMA (patching)	ton
Aggregate base course (patching)	ton
Aggregate base course (leveling)	ton
Unclassified excavation	cubic yard

A1.5.1. Concrete Pavement Rubblization. This item shall include full compensation for rubblizing the existing PCC pavement, rolling the pavement, and for all equipment, tools, labor and incidentals necessary to complete the work. In addition, this item shall include full compensation for all labor, equipment, tools, and incidentals necessary to furnish and apply water for dust control, provide test sections and test pits, saw-cut joints, cut and remove exposed concrete reinforcing material, remove joint filler and

other debris, cleanup, waste removal and disposal, and preparation of the rubblized surface prior to the HMA overlay.

A1.5.2. Removal of Existing Asphalt Overlay and Surface Patches. This item shall include full compensation for removal and satisfactory disposal of the existing asphalt overlay and asphalt surface patches, and for all equipment, tools, labor, and incidentals necessary to complete the work.

A1.5.3. Drainage System. This item shall include all material, hauling, labor, equipment, tools, and other incidentals necessary to install the drainage system as shown on the plans and in the project details. All cleanouts, outfalls, and other maintenance expenditures will be considered incidental to the work, and not paid for separately.

A1.5.4. HMA (Patching). This item shall include the provision of material, hauling, placement as directed by the contracting officer and compacting the material to 92% to 96% of maximum density, using sufficient labor and equipment.

A1.5.5. Aggregate Base Course (Patching). This item shall include the material, hauling, placement as directed by the contracting officer, and compacting the material, using sufficient labor, equipment, and water to achieve 95% of modified Proctor density in the material placed on the project.

A1.5.6. Aggregate Base Course (Leveling). This item shall include the material, hauling, placement as directed by the contracting officer, spreading, rolling, and compacting the material, using sufficient labor, equipment, and water to achieve 95% of modified Proctor density in the material placed on the project.

A1.5.7. Unclassified Excavation. This item shall include full compensation for the removal of existing rubblized PCC pavement, base course, and subgrade materials in unstable areas, including the removal and disposal of the material, and all labor, equipment, tools, and other incidentals necessary to complete the work.

A1.6. Notes to Designer.

A1.6.1. Drainage and Drainage System.

A1.6.1.1. Proper drainage is essential for good performance of any pavement and is a critical consideration in the construction of rubblization projects. Accumulation of excess water in granular layers below PCC pavements will cause premature pavement failure. Edge drains are generally specified to assure proper drainage of these granular layers. In the event that edge drains are not specified, shoulders should be removed to the level PCC pavement base to allow water to drain from problem areas.

A1.6.1.2. The Asphalt Institute recommends that a complete drainage system be installed on all rubblization projects. Even in dry climates, experience has shown that

edge drains provide value to the project by eliminating concerns regarding subgrade support characteristics or damage to the subgrade due to rainfall after rubblization and before placement of the asphalt surface. Underdrains are essential where the following conditions exist: sags in vertical curves; obvious pumping of existing PCC; the low side of super-elevated horizontal curves; and all other areas where drainage problems exist. Provisions for cleanouts and maintenance of the drainage system should be included in the construction details for the project.

A1.6.1.3. It should be noted that rubblized concrete, like granular bases, could hold water if not allowed to freely drain. If possible, rubblization operations should not be allowed until the drainage system has been in operation for a period of two weeks, particularly in moist climates. Placement of the HMA overlay should not be allowed it the rubblized concrete is wet or saturated.

A1.6.2. Removal of Existing Asphalt Overlay and Surface Patches. The contractor shall remove all existing asphalt from the PCC pavement surfaces to be rubblized. This includes existing asphalt overlays and asphalt surface patches. Commercial milling machines are typically used in this process. Any millings that are generated on the project can typically be incorporated into shoulder materials, avoiding additional costs for hauling and disposal of the millings. Rubblization of PCC pavement without removal of the existing asphalt will not be successful; therefore, complete removal of all asphalt surface materials is necessary.

A1.6.3. Rubblization Criteria. The rubblization criteria necessary for a successful rubblization project is dependent upon both the type of process to be used and the existing type of PCC pavement to be rubblized. Resonant breakers generally achieve smaller particle sizes than multi-head breakers. Plain jointed concrete pavement will rubblize to smaller dimensions throughout the entire pavement thickness. RPCC pavement will generally have particles of larger dimensions below the reinforcing steel, due to energy transfer into the steel. It is important that the bond between the reinforcing steel and the existing PCC pavement be broken during the rubblization process. RPCC is rubblized and seated using the same equipment and general procedures as provided in these specifications.

A1.6.4. Applicability. Rubblization is a controlled process for reducing deteriorated concrete slabs into a base material capable of supporting an HMA overlay. It destroys all slab action of the previously rigid pavement system, and converts the layer into a flexible pavement layer. This methodology has been found to be applicable for use on every type of PCC pavement.

A1.6.5. Underground Utilities — Load Restrictions. The rubblization machines may pose a hazard for underground utilities with insufficient cover depth. Care should be taken to properly locate, evaluate, and protect all underground utilities on the project. All equipment should strictly observe load restrictions on all bridges and culverts.

A1.6.6. Traffic.

A1.6.6.1. It is recommended that sufficient design thickness of the HMA overlay be installed over the rubblized PCC pavement before opening the project to traffic. The design thickness of the HMA layer is known to be sufficient for the anticipated loads on the project. Opening projects without sufficient design thickness could overstress the HMA layer or underlying layers.

A1.6.6.2. Traffic maintenance requirements often dictate that construction proceeds one lane at a time. This often means that the full design pavement thickness cannot be installed immediately after rubblization. Designers are advised to minimize traffic operations on partial pavement sections through careful attention to construction sequencing. Limitations on the extent of rubblized pavement in front of completed pavement sections have been used to minimize traffic exposure to partial sections and also limit the potential intrusion of rainfall into the rubblized sections. For example, statements such as, "In no instance shall more than 48 hours elapse between rubblizing the PCC pavement and placing the HMA overlay," may be included in the specifications. This statement is included in this guideline specification. Further definitions, such as, "The rubblization process shall not extend more than 1500 meters (5000 feet) in front of the completed HMA overlay," may also be included in project specifications when warranted.

A1.6.6.3. On rubblized pavements, there is potential for loose surface materials to become flying debris; traffic should not be permitted on the rubblized pavement until at least an initial 75-millimeter lift of HMA has been placed.

A1.6.7. Nondestructive Testing (NDT).

A1.6.7.1. These specifications do not require the use of NDT for monitoring the elastic modulus of the rubblized pavement. The surface of the rubblized PCC pavement is difficult to test and leads to fairly wide levels of test variability. While NDT is extremely valuable as a design and analysis tool, measurements during construction are difficult to validate and reproduce. Visual observations to determine the extent of rubblization and the destruction of the bond between the reinforcing steel and concrete are generally sufficient for this process.

A1.6.7.2. The Asphalt Institute recommends that NDT be performed on the completed pavement section, and repeated periodically throughout the course of the pavement's life. This data can provide valuable information concerning the adequacy of pavement sections over time and under changing traffic conditions.

A1.6.8. RPCC Rubblizing. The Asphalt Institute strongly recommends the use of the rubblization process for RPCC pavements. Other fractured slab technologies, such as crack/break and seat, have not been found to be nearly as successful as rubblization. Rubblization offers the owner a higher potential for superior long-term performance of an HMA overlay over existing reinforced concrete pavements.

SAW-CUT AND SEAL

A2.1. Description of Work. This work consists of a saw-cut and seal of the new HMA overlay over an existing PCC pavement. The work requires the precise referencing of the existing PCC pavement joints prior to the application of the HMA overlay, and the subsequent precise saw-cutting and sealing of new joints in the HMA after the completion of the overlay. The work shall be accomplished in accordance with the standard specifications, special provisions, and details shown in the plans.

A2.2. Equipment and Materials.

A2.2.1. Saw-Cut and Seal Equipment.

A2.2.1.1. Saw-cutting of the HMA overlay shall be accomplished by a pavement sawing machine that is capable of sawing the HMA overlay in a manner that will achieve the proper depth and width of the joint as specified in the project details. In addition, the machine shall be capable of precisely following the saw-cut alignment patterns that match the underlying PCC pavement joints.

A2.2.1.2. Sealing equipment shall be capable of filling the saw-cut joints with the specified sealant material as recommended by the material manufacturer. Sealant heating equipment shall be double-boiler type to avoid direct heating of the sealant material. The equipment shall have positive temperature control, mechanical agitation, recirculation pumps, and thermometers to monitor the temperature of the sealing material. All equipment shall be well maintained and operated according to manufacturer recommendations.

A2.2.2. PCC Joint Referencing Equipment and Materials. PCC joint referencing shall be accomplished using equipment, materials, and tools adequate to ensure the precise locations of the underlying PCC joints upon completion of the HMA overlay. The contracting officer shall approve the equipment and materials used in the process. The equipment may include survey pins, outside stakes, paint markings, magnets, string lines, or other devices. Equipment and materials used in this process is considered incidental to the work and will not be paid for separately.

A2.2.3. Joint Sealant Materials.

Note to Designer: *The proper selection of joint sealant materials based on the climate and functional characteristics of the roadway is essential to the good performance of this technique; therefore, consultation with sealant manufacturers is recommended before specifying the exact type of material to be used on the project.*

The joint sealant material shall be a hot-applied rubber-asphalt material that meets the requirements of ASTM D 3405, *Standard Specification for Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements*. The manufacturer's recommendations for

heating and applying sealant materials shall be carefully followed, with care taken not to exceed the recommended safe handling temperature.

A2.3. Construction Requirements.

A2.3.1. Preparation Prior to HMA Overlay.

A2.3.1.1. Prior to the HMA overlay, the existing concrete pavement shall be repaired as specified in the plans and specifications. This work is specified and paid for under separate line items not included in these guideline specifications.

A2.3.1.2. PCC joint referencing for all transverse joints and longitudinal joints shall be accomplished by the contractor using equipment, materials, and tools adequate to ensure the precise locations of the underlying PCC joints upon completion of the HMA overlay. Fixed reference markers shall be used. The process shall be capable of providing an asphalt joint within 25 millimeters of the underlying PCC pavement joint. The contracting officer shall approve the referencing process.

A2.3.2. Tack Coats.

A2.3.2.1. After completion of any necessary repairs to the PCC pavement and the proper referencing of the PCC pavement joints, the contractor shall apply a tack coat on the existing PCC pavement prior to placing the HMA overlay.

A2.3.2.2. Asphalt tack coat material shall also be placed between layers of HMA that have been exposed to traffic, or as directed by the contracting officer.

A2.3.2.3. The types and grades of asphalt to be used are contained in these project specifications, and shall be paid for under separate line items. The volume, in gallons, of the materials actually used in the work shall be determined as the basis of payment for the material.

A2.3.3. Reestablishment of Joint Locations. After the placement of the HMA overlay, the contractor shall carefully reestablish PCC pavement joint locations on the surface of new HMA overlay from the fixed referenced points. A chalk-line or other method approved by the contracting officer shall be used.

A2.3.4. Saw-Cut Joints .

A2.3.4.1. The contractor shall saw-cut joints in the HMA overlay at the reestablished joint locations directly above the PCC pavement joints. The joints shall be cut in accordance with the details shown on the plans. The saw-cut joints shall strictly conform to the width and depth requirements in the details.

A2.3.4.2. Saw-cut joints shall extend the full width of the lane and 0.91 meter (3 feet) beyond the edge of the underlying PCC pavement.

A2.3.4.3. Sawing may be accomplished either wet or dry; however, the cut joint must be thoroughly cleaned and dried prior to applying the joint sealant material. Dry sawed joints should be cleaned with compressed air, and wet sawed joints should be cleaned with a water jet and blown with compressed air to provide a clean, dry surface prior to sealing.

A2.3.5. Seal Saw-Cut.

A2.3.5.1. The saw-cut joints shall be approved by the contracting officer prior to the installation of the sealant material. The contractor shall place the sealant material according to the manufacturer recommendations. The contractor shall use all application procedures and equipment recommended by the manufacturer.

A2.3.5.2. Sealant materials shall not be used on the project until the manufacturer's recommended pouring temperature has been achieved in the heating equipment. The contractor shall not exceed the manufacturer's recommended duration of heating times for the sealant material.

A2.3.5.3. The sealant material should fill the joint so that after cooling, the level of the sealer will be 1.6 millimeters (0.0625 inch) to 3.2 millimeters (0.125 inch) below the pavement surface. Care should be taken by the contractor not to overfill the joints. The contracting officer may reject overfilled joints, and the contractor may be required to make corrections. The final appearance of the joints shall be of a neat, continuous seal across the entire lane.

A2.3.5.4. The manufacturer's recommendations for heating and applying sealant materials shall be carefully followed, with care taken not to exceed the recommended safe handling temperature.

A2.3.6. Progress of Work.

A2.3.6.1. The specified saw-cut and seal shall occur on the new HMA overlay within seven days after the initial cooling of the asphalt mat. The joint should be sealed before traffic is allowed on the sawed joint.

A2.3.6.2. If for any reason the final pavement surface will not be placed until the next construction season, the last placed pavement layer shall be saw-cut with a 25-millimeter-deep by 3-millimeter-wide cut above the PCC pavement joints before any evidence of reflective cracking develops. It is not necessary to seal this cut.

A2.3.6.3. The contractor will be responsible for maintaining the PCC joint references until the final lift is placed. If the delay in the final HMA lift was due to circumstances beyond the contractor's control, the contractor will be paid to reestablish the PCC joint locations on the final lift in proportion to the uncompleted work area and the additional saw-cutting required on the intermediate lift.

A2.4. Method of Measurement.

A2.4.1. PCC joint location and referencing shall be a lump sum bid item. Saw-cut HMA overlay is to be measured by the lineal foot using a calibrated measuring wheel, chain, or tape.

A2.4.2. Seal HMA overlay is to be measured by the lineal foot using a calibrated measuring wheel, chain, or tape.

A2.5. Basis of Payment. The accepted quantities will be paid at the contract unit price for the pay items listed in Table A2.

Table A2. Basis of Payment

Pay Item	Pay Unit
PCC joint location and referencing	lump sum
Saw-cut HMA overlay	linear foot
Seal HMA overlay	linear foot

A2.5.1. PCC Joint Location and Referencing. This is a lump sum bid item. The item will be paid 75% upon completion of the initial joint referencing work, and 25% will be paid upon reestablishment of the joint locations, as described in paragraph A2.3.

A2.5.2. Saw-Cut HMA Overlay. The actual measured length of saw-cut joints shall be the basis of payment. This item shall include full compensation for saw-cutting the HMA overlay in accordance with these specifications and the construction details shown on the plans, and for all equipment, tools, labor, and incidentals necessary to complete the work.

A2.5.3. Seal HMA Overlay. The actual measured length of joints sealed shall be the basis of payment. This item shall include full compensation for sealing the HMA overlay in accordance with these specifications and the construction details shown on the plans, and for all equipment, tools, labor, materials, and incidentals necessary to complete the work. In addition, this item shall include full compensation for all labor, equipment, tools, and incidentals necessary, but not limited to: cleaning pavement surface after saw-cut; cleaning and drying saw-cut joint prior to installation of joint sealant material; removal of excess sealant material and other debris; cleanup; and waste removal and disposal.

Note: Traffic control is a separate pay item not included in these specifications. Items involved in the preparation of the existing PCC pavement prior to the HMA overlay (such as slab replacements, undersealing, or crack repairs), asphalt prime coat, asphalt tack coat, and HMA pavement specifications are also not included in these guidelines, but should be included in the project specifications.

A2.6. Notes to Designer.

A2.6.1. Applicability of Saw-Cut and Seal.

A2.6.1.1. The underlying PCC pavement joints move both horizontally and vertically due to temperature and moisture changes, warping of the slab, and loading conditions that result in tensile, shear, and flexural forces. These movements produce excessive tensile stresses in the HMA overlay resulting in a crack in the overlay approximately above the existing PCC pavement joint. The reflective crack, if not properly treated, may meander and be of varying width. The saw-cut and seal technique establishes a weakened plane joint in the HMA overlay directly above the existing PCC pavement joint; the HMA joint can then be effectively sealed and maintained.

A2.6.1.2. The existing concrete pavement must be in good condition to successfully use the saw-cut and seal technique. Candidate projects include PCC pavements that are to be overlaid to increase structural capacity, correct defects such as polished surfaces or wheel-path wear, prevent additional minor scaling problems, and reducing noise. The existing PCC pavement must have only minor joint deterioration.

A2.6.1.3. Concrete pavements that have been built on good granular bases are the most adaptable to the saw-cut and seal technique.

A2.6.1.4. Concrete pavements that have deteriorated to the extent that they have lost structural integrity at the joints due to lack of subgrade support, pumping, slab rocking, blowups, random cracking, or severe concrete deterioration are NOT acceptable candidates for this technique. Deteriorated PCC pavements should use fractured slab techniques (crack and seat, or rubblization) prior to asphalt overlays.

A2.6.2. Precision of Joint Referencing. Precise joint referencing is critical to success with this technique. Fixed reference markers are required in these specifications. Tape-measured locations are not considered precise enough. Slightly misplaced markings (±25 millimeters from the underlying PCC pavement joint) can lead to another crack that can easily pit or erode out. While this procedure is time consuming and costly, it is necessary for a successful project and will ensure minimal future maintenance costs.

A2.6.3. Saw-Cut and Seal Technique Timing. Experience has shown that the saw-cut and seal must occur immediately following placement of the HMA overlay to prevent random and uneven cracking of the asphalt mat. Even well-referenced joints have experienced higher deterioration rates resulting in higher project maintenance costs when the saw-cut and seal was delayed. These specifications require timely completion of the process. In the event of a delay in the placement of the final lift, the contractor will be compensated for the additional work that will be required if the delay was created by circumstances beyond his control. It is in the best interest of both the owner and the contractor to complete the work in a timely manner.

A2.6.4. Transverse Joint Saw-Cut and Seal. All transverse joints must be saw-cut. The saw-cuts must always exactly match the joints in the underlying PCC slabs. Joint locations should be identified and referenced in each individual lane if the joints of the adjoining lane slabs do not line up.

A2.6.5. Longitudinal Joint Saw-Cut and Seal. The Asphalt Institute recommends that longitudinal joints be saw-cut. Some agencies do not specify saw-cuts for longitudinal joints when the joints are in good condition, when certain width and alignment characteristics exist, or when the expected extent of lateral movement is minimal. The best conservative approach is to saw-cut and seal both the longitudinal and transverse joints.

A2.6.6. Saw-Cut Joint Details. The saw-cut joint details (depth and width of cut) should be contained in the project plans. These details are generally dependent upon the slab length and pavement thickness of the underlying PCC pavement.

A2.6.7. Drainage and Drainage System. Proper drainage is essential for good performance of any pavement and must be considered in any rehabilitation operation. Accumulation of excess water in granular layers below PCC pavements will cause premature pavement failure. Ditches should be checked for proper slope and depth. Grades should be checked to assure that the water will drain. Longitudinal edge drains may be necessary to assure proper drainage of the granular layers in problem areas. Drainage repair can be time consuming and costly, but proper drainage is essential to ensure the performance of rehabilitated pavements. These guideline specifications do NOT include pay items for this work.

A2.6.8. Traffic.

A2.6.8.1. Handling traffic during the saw-cut and seal process is similar to that involved with normal HMA overlay projects and proper safety procedures should be followed.

A2.6.8.2. Residue from the sawing operation must be cleaned from the pavement prior to sealing the joints. If the cleaning operation interferes with or will cause damage to the traffic in adjoining lanes, the contractor should be required to provide protective screening.

A2.6.9. Tack Coat Asphalt.

A2.6.9.1. Tack coats should be used as part of a successful saw-cut and seal project, and on nearly all asphalt paving projects. They provide owners with an extra measure of success at a relatively low cost. Specifications for the use of tack coat material can be found in many different Asphalt Institute publications, and should be included under a separate heading in the project specifications.

A2.6.9.2. Temperature-volume correction data for asphalt quantities are contained in the Asphalt Institute MS 6, *Asphalt Pocketbook of Useful Information.*

A2.6.10. NDT. These specifications do not require the use of NDT for quality control purposes. NDT, however, is extremely valuable as a design and analysis tool, and can be used to ensure the adequacy of the completed pavement section. The Asphalt Institute recommends that NDT be performed on the completed pavement section, and repeated periodically throughout the course of the pavement's life. This data can provide valuable information concerning the adequacy of pavement sections over time and under changing traffic conditions.

CRACK/BREAK AND SEAT

A3.1. Description of Work. This work consists of cracking/breaking and seating the existing PCC pavement by inducing cracks and seating the pavement uniformly on the subgrade or subbase prior to placing a new HMA overlay. The work shall be accomplished in accordance with the standard specifications, special provisions, and details shown in the plans.

A3.2. Equipment.

A3.2.1. Cracking/Breaking Equipment. Cracking/breaking shall be accomplished with a machine equipped with a modified pile or drop hammer utilizing a minimum 1.8-meter-wide transverse striking bar. The hammer shall be capable of delivering sufficient energy to crack the pavement full depth. Machines of other design that will accomplish similar results may also be used.

A3.2.2. Seating Equipment. Seating shall be accomplished using a pneumatic-tire roller weighing at least 45 metric tons, with a tire inflation pressure of 690 kilopascals (100 pounds per square inch). A towed-type, single-axle, pneumatic-tire roller is preferred, but rollers of other design that will produce similar results may also be used with the approval of the contracting officer.

A3.3. Construction Requirements.

A3.3.1. Preparation Before Paving. Prior to the cracking/breaking operations, existing asphalt overlays and patches shall be removed from the concrete surface.

A3.3.2. Test Strip to Establish Breaking Pattern.

A3.3.2.1. Before the cracking/breaking operations begin, the contracting officer will designate a test section of approximately 150 meters by 3.6 meters (500 feet by 12 feet). The contractor shall crack the test section using varying degrees of energy and various striking patterns until a procedure is established that will crack the pavement to the required extent. The procedure shall be mutually agreed upon by the contracting officer and the contractor.

A3.3.2.2. Pavement cores from the test section shall be provided by the contractor to determine the actual extent and depth of the cracking before an agreement between the contracting officer and contractor is completed. The established procedure shall be used to crack the remainder of the pavement, provided the cracked segment conforms to the specification requirements. When cracking test sections, the contractor shall furnish and apply water to dampen the pavement surface so the extent and severity of cracking can be readily determined.

A3.3.3. Crack Pattern.

A3.3.3.1. The existing concrete pavement shall be cracked one lane at a time by making a single pass with a drop hammer or other approved machine. The cracked pavement segments shall have a maximum nominal diameter of 0.91 meter, as determined by the contracting officer.

Note to Designer: *The crack pattern is part of the design process, and this diameter is variable based on subgrade and base materials, and other factors. Please refer to Asphalt Institute MS17 for additional information concerning the selection of the maximum nominal diameter to be specified for the project.*

A3.3.3.2. The contractor shall furnish and apply water for random checks of the crack pattern at least twice each day, or as ordered by the contracting officer. The energy or striking pattern shall be adjusted if the contracting officer deems it necessary based on the results obtained from the check section. When adjustments to the crack pattern are required, the contractor may be required to provide cores of the slab to demonstrate that the slab is cracked throughout the entire section.

A3.3.3.3. Penetration, spalling, or shattering on the existing surface shall be avoided. If this becomes excessive, as determined by the contracting officer, the cracking shall be stopped and adjustments made to the equipment.

A3.3.4. Cleaning. After the pavement has been cracked, the surface shall be cleaned using power brooms, compressed air, or other approved methods to remove all loose and spalled concrete, dirt, and other foreign material. The waste material may be disposed of on the adjacent shoulders. The waste material shall not be placed on the topsoil.

A3.3.5. Patching. If sections become unstable due to expansion of the existing concrete pavement, they shall be removed to a maximum length of 1.2 meters in length by 3.7 meters in width, and replaced with full-depth HMA. Patching procedures shall conform to the standard specifications. Patching will be paid as a separate bid item as provided in these specifications.

A3.3.6. Seating Procedure.

A3.3.6.1. Within 24 hours prior to placing the HMA overlay, the cracked concrete shall be rolled with a 45-metric-ton pneumatic-tire roller, as specified. Two passes of the roller will be required, covering the entire surface area to be compacted. For this operation, a pass is defined as forward and back over the entire surface area. The roller speed shall not exceed 4.8 kilometers per hour (3 miles per hour).

A3.3.6.2. The contracting officer or his representative shall follow closely behind the roller observing the slab being loaded. All slabs observed to move under the roller shall be marked with paint. The mark shall be made as close as possible to the point of rotation of the slab. Any slab section that does not seat well under the roller, as

determined by the contracting officer, shall be cracked into smaller sections, cleaned, and rolled again until the slab segments are firmly seated on the subgrade or subbase.

A3.3.6.3. Any soft spots or failed areas identified in the base or subgrade by the heavy rolling shall be repaired and patched with full-depth HMA (patching) prior to placing the HMA overlay.

A3.3.6.4. Temporary reductions in the roller ballast may be allowed in limited areas by the contracting officer to prevent damage to buried structures or for other acceptable reasons.

A3.3.6.5. Rolling shall not be performed on excessively wet subgrades.

A3.3.6.6. Overrolling shall be avoided.

A3.3.7. NDT. NDT equipment may be used to monitor the construction quality of the cracking operation.

A3.3.8. Breaking RPCC Pavement.

A3.3.8.1. RPCC pavement shall be broken and seated using the same equipment and general procedures as provided in these specifications. The extent of required cracking is much greater than for crack and seat. RPCC pavements shall be broken in such a manner that 80% of the fractured slabs are smaller than 0.6 meter (2 feet) in diameter, and none are larger than 0.76 meter (2.5 feet) in diameter, as determined by the contracting officer.

A3.3.8.2. NDT requirements provided in these specifications shall apply to all RPCC pavements. To assure that the in-place modulus will be below the critical value of 7000 megapascals (1,000,000 pounds per square inch), it is recommended that the crack spacing be less than 450 millimeters (18 inches).

Note to Designer: *There is a substantial reduction in the structural capacity of the break and seat sections, which must be accounted for in the design phase for the HMA overlay.*

A3.3.9. Seating RPCC Pavement. Because the existing slab is broken more thoroughly in break and seat than in crack and seat operations, a minimum of five passes with the 45-metric-ton pneumatic-tire roller shall be required to achieve adequate seating of the fractured slabs.

A3.3.10. Sawing RPCC Pavement. The contractor shall provide transverse sawing at routine intervals on each broken slab to cut the reinforcing steel and assure debonding in the transverse direction.

A3.3.11. PCC/Reinforcing Steel Bond Breaking on RPCC Pavement. The effectiveness of the equipment in both cracking the concrete and breaking the bond between the reinforcing steel and concrete shall be determined by the engineer. The contractor shall make all necessary adjustments in procedures and equipment to ensure that the bond is broken.

A3.3.12. Joint Cleaning and Sealing. All loose materials should be removed from the joints using compressed air or other methods prior to application of the tack coat. Where joints are of sufficient size to pocket water or provide a channel from which water will be pulled from beneath the joint during the placement of the HMA overlay, the joint shall be sealed with an approved joint sealant material. Joints that are to be sealed shall not be overfilled with joint sealant materials.

Note to Designer: *Reflective cracking will normally be observed in the asphalt overlay by the end of the day when these forces are present.*

A3.3.13. Tack Coat Asphalt. The contractor shall place an asphalt tack coat of an approved type at an application rate of 0.26 to 0.38 liter per 0.84 square meter (0.07 to 0.10 gallon per square yard) over all cracked/broken and seated surfaces prior to placing the HMA overlay. When necessary, the contracting officer may order changes to the material type and application rate to ensure a sufficient bond between the PCC and HMA layers.

A3.3.14. Edge Drains.

A3.3.14.1. Edge drains shall be provided, at a minimum, where the following conditions exist: sags in vertical curves; obvious pumping of existing PCC; the low side of super-elevated horizontal curves; and all other areas where drainage problems exist.

A3.3.14.2. The design and extent of the edge drain system on the project shall be as shown on the plans. A separate pay item shall be provided when edge drains are determined as necessary for the project.

A3.3.15. HMA Leveling Course. The surface shall be brought to a uniform cross-section with a HMA leveling course as specified on the plans.

A3.4. Acceptance.

A3.4.1. Crack Pattern. The crack/break pattern shall conform to the construction requirements contained in these specifications. Areas that do not conform will not be accepted by the contracting officer.

A3.4.2. Cores. Pavement cores shall be required as stated in paragraph A3.3.

A3.4.3. NDT.

A3.4.3.1. When required, NDT back-calculated moduli for the fractured PCC layer shall be obtained and a project coefficient of variation (CV) calculated (CV = 100 x standard deviation/mean modulus). The CV value is used to determine construction quality control. The contractor shall maintain good to excellent control.

Table A3. Quality Control

Construction Quality Control	CV Limits
Good to excellent	CV < 30%
Fair to good	30% < CV < 50%
Poor to fair	CV > 50%

A3.4.3.2. The modulus of the fractured layer of 95% or more of the project area shall have a value of less than 7000 megapascals (1,000,000 pounds per square inch) and more than 3500 megapascals (500,000 pounds per square inch).

A3.4.3.3. Pavement cores shall be obtained on a regular basis to correlate the back-calculated moduli with the actual pavement thickness when NDT is used for quality control and acceptance purposes.

A3.5. Method of Measurement.

A3.5.1. Cracking/breaking and seating concrete pavement will be measured by the square yard.

A3.5.2. HMA (patching) will be measured, as described in the standard specifications, by truck scales, or if the plant is so equipped, by an automatic batching and mixing control system with an automatic digital printer for batch weights and component materials weights. The weight in tons of the HMA (patching) material actually used in the work shall be determined.

A3.5.3. Asphalt for Tack Coat. The quantity of asphalt used for tack coat will be the liters (gallons) used at 15.5 °C (60 °F), computed from the quantity measurements in the distributor tank before and after the application.

A3.6. Basis of Payment.

A3.6.1. The accepted quantities will be paid at the contract unit price for the pay items listed in Table A4.

Table A4. Basis of Payment

Pay Item	Pay Unit
Crack/break and seat of concrete pavement	square yard
HMA pavement (patching)	ton
Tack coat asphalt	gallon

A3.6.2. Payment will be full compensation for all work and materials required to complete the item. This will include, but not be limited to, full compensation for all labor, equipment, tools, incidentals necessary to crack/break and seat the existing concrete pavement, furnishing and applying water, providing test sections, clean up, waste disposal, and furnishing and applying tack coat asphalt materials prior to the HMA overlay.

Note: Traffic control is a separate pay item not included in these specifications.

A3.7. Notes to Designer.

A3.7.1. Applicability.

A3.7.1.1. Crack/break and seat construction is a controlled process for inducing cracks into deteriorated concrete slabs to reduce their effective slab length, then seating the pieces onto the subgrade by rolling to eliminate any rocking movements; this causes the concrete to perform as a semi-rigid system. If the site or pavement conditions will not allow this methodology to perform as intended, rubblization of the existing PCC pavement should be considered.

A3.7.1.2. Performance of crack/break and seat projects depends upon the proper cracking/breaking of the existing concrete. The slab must be fractured the entire depth to alleviate horizontal movements below the HMA overlay. Experience has revealed that cracks induced at the surface of the slab have not always penetrated the full depth of the slab. The equipment used to make the crack and the load setting should be adjusted for the slab thickness and subgrade conditions of the project.

A3.7.2. Drainage.

A3.7.2.1. Proper drainage is essential for good performance of any pavement and is a critical consideration in crack/break and seat construction. Accumulation of excess water in granular layers below PCC pavements will cause premature pavement failure. Edge drains are generally specified to assure proper drainage of these granular layers. If edge drains are not specified, shoulders should be removed to the level of the base of the PCC pavement to allow water to drain from problem areas.

A3.7.2.2. Fractured concrete is permeable, and like granular bases, can hold water if not allowed to freely drain; therefore, if possible, cracking operations should not precede the seating operation and overlay placement by more than 24 hours in moist climates. Placement of the HMA overlay should not be allowed if the fractured concrete is wet or saturated.

A3.7.3. Seating Equipment. The most successful cracking/breaking and seating projects are those that have applied a seating effort of two passes with a 45-metric-ton pneumatic-tire roller. Generally, a few passes with a heavy roller have been more practical and produced better results than numerous passes of a lighter roller. Steel and vibratory drum rollers tend to have a bridging action over the cracked pieces, and for this reason are not specified.

A3.7.4. Overrolling. Once seated, any additional roller passes over the slab fragments may be detrimental. Additional passes may break the aggregate interlock between slab fragments, resulting in a lower strength coefficient assignment for the fractured slab. Also, excessive rolling may overstress the base layer or subgrade materials. An increase in deflections of the fractured slabs may be the result. Overrolling should be avoided, as noted in these specifications. Refer to Asphalt Institute MS17, Chapter 11, for a discussion of strength coefficient values.

A3.7.5. Rolling in Wet Conditions. Rolling in wet conditions should be avoided, as noted in these specifications, because this may cause non-uniform or excessive deformation of the fractured slabs.

A3.7.6. Underground Utilities/Load Restrictions. The cracking/breaking operations, especially the use of the 45-metric-ton pneumatic-tire roller in the seating operation, may pose a hazard for underground utilities with insufficient cover depth. Care should be taken to properly locate, evaluate, and protect all underground utilities on the project. All equipment should maintain stringent load restrictions on all bridges and culverts. The roller should not operate within 3 meters (10 feet) of any such structure unless studies show it is safe to do so. A lighter roller should be required to seat the broken pavement in these areas.

A3.7.7. Traffic.

A3.7.7.1. There are several approaches to controlling traffic over the cracked/broken and seated pavements. The most successful approach is to require the overlay to be placed, before the expiration of a maximum time limit, prior to opening the section to traffic, as required in these specifications. The cracking operation is then limited to some specific distance (e.g., 1500 meters [5000 feet]) in front of the paving operation. If it becomes necessary to open traffic over a cracked pavement segment prior to placement of the HMA overlay, the surface must be made acceptable and maintained for traffic by sweeping, patching, and removing any loose material that could result in liability due to incurred damage. Long-term or heavy trafficking of thin HMA layers before placing the entire overlay thickness should be avoided.

A3.7.7.2. Before opening break and seat projects to traffic on a temporary basis, at least one layer of HMA shall be placed and allowed to cool because of the lessened slab integrity. This thin asphalt layer should not be exposed to traffic more than 14 days before the entire overlay thickness is placed to avoid premature damage to the overlay.

A3.7.8. Tack Coat Asphalt. Temperature-volume correction data for asphalt quantities are contained in Asphalt Institute MS6.

A3.7.9. RPCC Breaking and Seating Policy. The performance of HMA overlays is dependent upon achieving both an adequate crack pattern and a breaking of the bond between the reinforcing steel and the concrete. If the use of this slab reduction technique is specified, it is critical that the bond between the reinforcing steel and concrete be destroyed during the construction process.

A3.7.10. Breaking and Seating Quality Control with NDT. These specifications require the use of nondestructive testing for all break and seat projects. Simple observations of crack patterns and cores have not proven sufficient to determine the destruction of the bond between the reinforcing steel and concrete.

A3.7.11. RPCC Rubblizing. The Asphalt Institute strongly recommends the use of rubblizing for RPCC pavements. Although these specifications include breaking and seating, rubblization offers the owner a higher potential for superior long-term performance of an HMA overlay over existing reinforced concrete pavements.

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